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ABSTRACT

This case study identifies the feasible approaches to integrate laptops into a science learning environment in middle school. The observation of learning activities and teaching strategies took place in the 8th grade science classroom with seventeen students for five class periods and data from the teacher's opinion gathered by interview. The results reveal the strategies the teacher used with laptops in the classroom including problem-based learning, project-based learning, collaborative learning, hands-on activities, and having students use laptops as cognitive tools. With appropriate strategies, laptops can be used as cognitive tools and they can enhance the possibility of shifting the teacher's role from lecturer to facilitator. Integrating laptops into the classroom involves the following: making use of laptops as cognitive tools, employing constructivist approaches, providing curriculum support, managing logistics of the classroom, and reducing distraction. (Contains 16 references.) (Author)

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Integration of Laptops into a K-12 Learning Environment: A Case Study of a Science Teacher in the Middle School

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Abstract: This case study identifies the feasible approaches to integrate laptops into a science learning environment in the middle school. The observation of learning activities and teaching strategies took place in the 8th grade science classroom with seventeen students for five class periods and the data from teacher's opinion gathered by interview. The results report the strategies the teacher used with laptop in the classroom including problem-based learning, project-based learning, collaborative learning, hands-on activities, and have students to use laptop as a cognitive tool. With appropriate strategies, laptop can be used as a cognitive tool and enhance the possibility of shifting teacher's role from a lecturer to a facilitator. Integrating laptops into classroom should consider the following issues: make use of laptop as cognitive tool, employ constructivism approach, provide curriculum support, manage logistics of classroom, and reduce distraction.

Pervasive computing can enable learners, teachers, and parents to have continuous access to computing technology. By taking the advantage of portable technologies such as laptops to establish a pervasive computing environment, students can be empowered to learn with technology anytime, anywhere. Recognizing the potential benefits of pervasive computing, a coeducational, independent, college preparatory day school in the southeastern region of the United States has worked for two years to integrate laptop computers into middle grade core subjects (language arts, social studies, math, and science) with a wireless networking infrastructure.

Information technology has been shown to motivate students and, computer-assisted learning can make a notable addition to learning and understanding science concepts but its value will lie in apt use and this will depend upon teacher judgment and expertise (Rodrigues, 1997). Successful implementation of technology in an education setting requires more than merely providing resources and a hospitable environment. Collaboration among the participants is an essential feature of the formula. Collaboration in itself does not lead to success in achieving change if those involved do not embrace a shared vision or a perceived need of technology implementation. Moreover, integrating technologies with education requires a reconceptualization of the classroom environment and the teaching and learning strategies employed therein (Woodrow et al., 1996).

Aware of the laptop successes and challenges documented at other schools, the technology leaders at the school used in this study contacted external evaluators to conduct a long-term evaluation of the use of portable technologies in their school (Hill, et al., 2001). The findings of the evaluation from the last two years indicates that even though teachers were enthusiastic about using laptop into their classroom, some of them felt frustrated because they perceived a need for more practical strategies about how to integrate the laptop into the learning environment. As a component of the overall evaluation project, this study sought to: 1) identify learning activities that use the laptop, and 2) identify the strategies the teacher uses during the learning activities in the learning environment to integrate the laptop.

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The description of the problem

During the Spring of 2000, the school offered a series of workshops (known as 20-Minute Modules) to prepare middle school teachers and administrators to participate in a wireless laptop learning environment. While the workshops were useful, several suggestions were offered during the teacher interviews at the end of the year. One teacher suggested that the technology training and the strategies of teaching learning should be separated. Another teacher mentioned a need for personalized training to match her/his curriculum. Yet another teacher stated they needed training on technology integration. While training received to date has been useful, it appears that the teachers are still trying to figure out the feasible approaches to integrate the new portable technology into the learning environment.

One area that holds particular promise in terms of technology integration is science computer applications in science education could include word-processing reports, using data-loggers, spreadsheets, databases, simulations, multimedia and the Internet, for data collection and analysis (Rodrigues, 1997). For example, by allowing pupils to carry out complex calculations and present the results quickly and easily, they are able to concentrate on the important scientific principles underlying their work rather than on the tedium of the number crunching that can so often get in the way of understanding (Carson, 1997). In addition, modeling could be used for investigations and multimedia authoring for communication information. For example, by creating a dynamic computer model of the thing to be studied, and manipulating that model to changes and new influences, student gain a sense of how the thing itself works (Carter, 1998).

Research design

Based on the many opportunities of integrating the laptop into the science learning environment, this study sought to develop a strategy to help teachers systematically and successfully integrate the laptop in the middle school to enhance student learning. This study focused on one classroom of one eighth grade science. Students and the teacher have their own laptops and they can access to the Internet anytime, anywhere with their laptops. The classroom context is a science class covering ecology, earth science, and physics. The class meets five days a week during the semester. Participants study astronomy unit when the researcher doing observation. Seventeen 8th grade students from the same classroom of the science teacher were selected to participate in this study. The majority of the students received their laptops two years ago and are computer literate. (note: some students are new to the academy so have not had their computers for two years) The teacher has 7 years experience of teaching science and two years experience of using the laptop into the learning environment.

The design of this study is a case study, utilizing qualitative research methods because the researcher wants to generate data rich in detail and embedded in the context. According to Stake (1994), in the intrinsic case study, no attempt is made to generalize beyond the single case or even to build theories. However, as Jennifer Mason puts it:

> *I do not think qualitative researchers should be satisfied with producing explanations which are idiosyncratic or particular to the limited empirical parameters of their study... Qualitative research should [therefore] produce explanations which are generalizable in some way, or which have a wider resonance (1996:6).*

Purposive sampling guided by time and resources is a positive answer to the question of how we can obtain generalizability. Purposive sampling allows us to choose a case because it illustrates some feature or process in which we are interested (Silverman, 2000). As Denzin and Lincoln put it:

> *Many qualitative researchers employ...purposive, and not random, sampling methods. They seek out groups, settings and individuals where...the processes being studied are most likely to occur (1994:202).*

The researcher focused on a single case by purposive sampling because unique qualities of the learning environment can promote understanding, inform practice for similar situation and allow access. Due to identify

the teaching strategies the teacher employs in the learning environment, on-site observation of the activities with the laptop and interview with the teacher are selected.

This study gathered the qualitative data by two primary methods: 1) conducted observation in the classroom to see how the middle school science teacher integrates the laptop into the learning environment and the reactions of students with observation protocol, and 2) an interview with the middle school science teacher to gather detailed information about the experience. Other sources of data were also used to inform the results of the study; including surveys from the overall evaluation effort and informal discussions with the overall evaluation team.

Data analysis

The researcher used descriptive statistics to include frequency of activities occurred in the learning environment and activity structure. The data from field observations were analyzed based on the categories in the observation checklist. The interview session was recorded on audiotape. The transcribed teacher interview protocol was compared with the data drawn from observations and surveys. The interview was analyzed by the inductive approach and themes were identified. The data of surveys done by the external evaluation team from the last two years of the four-year longitudinal evaluation about the science teacher's view on teaching and learning, computer use for teaching, and the descriptions of his teaching and learning environment were synthesized with the data from observations of actual using the laptop in the learning environment. The teacher's self-description of the experience was gathered from the interview.

There are some limitations might limit the validity and reliability of the results of this study. First, the observation time was limited due to limited personnel; the researcher was not able to participate in each science. Second, any possible generalization of the results is limit to the middle school in science. Third, the results may not apply to the teacher who is not equipped with the high computer literacy because the teacher in this middle school has been through training in using a laptop.

Results

The case study revealed some interesting results. One key to successfully integrating the laptop into learning environment is how the strategies are being employed. In this study, the strategies the teacher used with the laptop included problem-based learning, project-based learning, collaborative learning, and hands-on activities. The teacher also had students using the laptop as a cognitive tool, representing their knowledge with some application such as creating a Webpage, or a PowerPoint presentation, or spreadsheet graphics. Most of the strategies that the teacher used also clarified the result of literature review (Wiesenmayer & Koul, 1998; Woodrow et al., 1996; Scanlon, 1997; Devitt, 1997) including the value of an inquiry-based approach, project-based activities, collaborate learning, and using a variety of resources available through the Internet to integrate technology.

Another key to successfully integrating the laptop appears to be the role of the teacher. The teacher's role changed from that of a lecturer and transmitter of knowledge to that of a facilitator, guiding students to take advantage of opportunities to develop their inquiry skills; from being a conclusion-drawer to becoming a curriculum planner and initiator, while using the computer and other resources to provide science information (Levine & Donitsa-Schmidt, 1996). The particular advantage for science educators is that there is a teaching point to be made in using a collaborative context for science learning, stressing that scientists usually work in teams and that science is a social activity (Scanlon, 1997).

Yet another key to successful laptop integration is the curriculum support to come up the ideas about how to integrate laptop into the learning environment. Between grading and making test and keeping up with their

lessons, there is no time for teachers to be able to sit and look for valuable and valid resources. Providing resources that will assist teachers with generating the ideas is important, as is providing time to tryout and revise the ideas.

Classroom logistics is another key in successful integration of the laptop in the learning environment. Even though they have wireless Internet connection, the laptop still needs a power cord to operate. Currently, the cords are all over the floor and create challenges for moving around the classroom. Set up or the learning space needs to be considered.

A final factor revealed in this study relates to student attention. Students can configure laptops with their own personal interest. For instance, they can setup different wallpaper for desktop, install fancy screensavers and entertainment applications. While important, these can also become sources of distraction. Balancing personalization of the tools while maintaining a focus on use for learning is another key factor to the successful integration of the laptops.

Implications

The data gathered suggests a number of recommendations that are applicable in the learning environment with laptop. Implementation of these strategies may assist with the successful integration of the laptops.

1. *Make use of laptop as cognitive tool:* Using software like spreadsheet, PowerPoint, image processing, web construction and multimedia authoring tools enable student to create charts, graphics, presentations, projects, and websites easily. They can use these tools to represent and construct their knowledge toward concepts and enhance their cognition. Therefore, laptop can be used as a cognitive tool (Jonasson & Reeves, 1996) with appropriate strategies and enhance the possibility of shifting teacher's role from a lecturer and transmitter of knowledge to a facilitator.
2. *Employ constructivism approach:* learning and instructional practices in science classrooms should be flexible and form a constructivism learning environment. (Levine & Donitsa-Schmidt, 1996). To enable a constructivist learning environment and switch the structure from teacher-centered to learner-centered, teacher should provide students chances to construct their own knowledge representations with laptop.
3. *Provide curriculum support or formal channel to share instructional ideas:* Teachers don't have enough time to develop appropriate tools for laptop in each unit is a problem for integration. Laptop just becomes a tool to replace pen and paper. Having someone who is good with computers and laptops, understand teaching techniques, pedagogy and familiar with curriculum to design the ready-to-use activities as resources for teacher to adapt is a strong need to implement the laptop environment. Or create an official website for sharing valuable resources that can provide teachers a channel to access to all kinds of tool for specific units.
4. *Logistics of classroom:* Although the learning environment is wireless for access to the Internet, laptop still needs cord to get power because kids seldom remember that they have to recharge laptops everyday. Ideally there would be enough plugs under every desk in the floor or a desk with plus. Considering the arrangement of desks, plugs, and cords before using laptop in the classroom is a primary work.
5. *Reduce distraction:* students can configure laptops with their own personal interest; for instance, install fancy screensaver and entertaining applications. They may miss the lecture and put attention to these distractions. Teacher may needs to set up classroom rule to prevent students browsing unrelated information in class.

Conclusion

Bringing wireless laptop into learning environment has some strength. The capability of accessing to the Internet anytime anywhere and being portable extends the learning environment beyond the boundary. This advantage makes the learning environment turns into classroom, lab, library, and the authentic context based on the instructional goals without the physical limitation. Carter (1998) indicated that in the ecology class, students enter the full ecological context, doing it as a biologist or ecologist would, gather data and convene to discuss the data and patterns, formulating conclusions and new questions about the ecological relationship in the environment that supports it. This kind of real experience is most powerful, because the learning is situated in the most authentic context possible. Moreover, teacher can collect ready-to-use tools for laptop from the Internet and share that easily with other teachers. Teachers perceived Internet as a major tool for teaching collaborative and investigative practices of science and scientists and they also became aware of the possibilities and the problems created by both the nearly unlimited quantity of information available on the Internet and the limited quality and relevance of much of that information (Wiesenmayer & Koul, 1998; Jackson et al., 1997). Students can seek information on the Internet and email peers to share their knowledge and accumulate resources collaboratively. Besides, with the laptops in the classroom, it saves lots of time because they don't have to go back and forth between media center and classroom.

The strategies of integrating laptop into learning environment depend on the feature of learners and subjects, learning goal and objectives. There is no reason that laptop should be involved in each activity. Teacher should use laptop for meaningful purposes. For example, for middle school kids, it's better to use mixed up strategies with and without laptop because it's impossible to ask kids sit in front of laptop all day even these tools are excellent. The ideal situation is not over and not under use. It has to be integrated but there still things have to stay, not total transition. Finding a balance in use and house remains a challenge for further research.

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